5p

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SEMI-ANNUAL STATUS REPORT FOR PERIOD 10-1-62 to 3-31-63

GRANT NsG-210-62

CODE 2A

UNPUBLISHED PRELIMINARY DATA

I. Part of this progress report is attached and deals with a technical evaluation of a one-inch miniaturized vidicon. As a supplement to this we have attempted to obtain a re-loan of this equipment following its modification by RCA to correct the difficulties outlined in the report. Tiis re-loan of the equipment is feasible and will be accomplished during the summer. Persenal contact with Dr. Lindsay of the Goddard Space Flight Center has been established for this purpose and he has been provided with a review of our program.

II. Ultraviolet emitting phosphors. A new ultraviolet emitting phosphor was developed by Derby Luminescents and supplied to the Rauland Tube Corporation and Dr. Szegho of this organization has provided us with scanner tubes screened with this phosphor. This phosphor appears to be the best ultraviolet emitting phosphor we have yet encountered and Dr. Szegho is in the process of removing impurities from the phosphor so that a tube of high standards can be obtained.

III. The stepping spot microscope referred to briefly in the past progress report for the period of 12-1-61 to 5-1-62 has been improved and it will be our purpose to adapt this principle to film scanning rather than direct specimen scanning. The reason for this is that higher signal to noise ratios can be achieved by scanning the film than can be achieved by direct scanning of the specimen; thus much clearer signals may be obtained and with greater rapidity. There exists the possibility that this general system may be adapted to use with a laser in combination with fiber optics. Preliminary investigations of these principles are now underway.

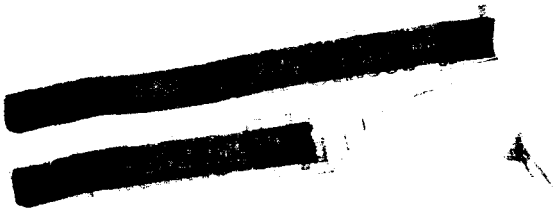
IV. A complete prototype of the necessary equipment for cell studies in satellites has been fabricated. This equipment consists of a 16 mm. time lapse motion picture camera, miniaturized phase contrast microscope, a battery operated light source, an automatic feeding device, a timer to control the feeding device and the photographic system. The time available is such that one photograph per minute will be obtained for 3 hours for each 24 hour period of a 21 day cycle. This equipment is presently at the Ames Research Center at Moffett Field where it is undergoing an on-the-bench test for 21 days. The equipment is giving a superior performance and no technical difficulties are expected in modifying it for inflight studies. Preliminary experiments have been conducted to establish the effects of radiation on plus X reversal 16 mm. motion picture film. The film was exposed to varying doses of X-rays up to a total of 40 R. The source was a cobalt 60 unit. These preliminary data indicate that this amount and type of X-radiation delivered to this type of film will not induce fogging sufficient to obscure cellular images previously imprinted on the film. Further studies of the equipment assemblage, the cell maintenance problem, and the radiation effects on film are being pursued.

V. Studies of the effects of high gravity on the bacteria E. Coli are well advanced. It has been established that these bacteria show a decrease in all aspects of growth when exposed to 100,000 G. This effect does not appear to be due to packing. Ultrastructural studies of these bacteria have demonstrated that they continue to grow but do not divide. This results in the production of giant forms of bacteria. To my knowledge this dissociation of growth from cell division has been previously only observed with ionizing radiation effects. As soon as the ultrastructural data are complete metabolic studies of these bacteria will be begun.

VI. The centrifuge microscope has been used to study the effects of low orders of gravity on amoeba for prolonged periods of time. It has been seen from these studies that amoeba can exist for prolonged periods of time in gravitational fields of 20 G. They do show disturbances in the normal manner of locomotion but these appear to be non-lethal. They reproduce as rapidly as controlled amoeba under similar conditions at 1 G. At 40 G the amoeba develop marked disturbances in locomotion and these disturbances show a striking similarity to the disturbances of locomotion exhibited by amoeba being irradiated with ultraviolet light. These studies are now in the process of being altered by substituting planaria (flat worms) for the amoeba at 40 G. The purpose of these studies will be to record these data by time lapse motion pictures to determine whether or not the phenomenen represent irreversible changes with respect to time and to see whether or not they are hereditary.

VII. Ultrastructural changes after the cells have been subjected to ionizing irradiation have been established for the various organelles as characterized by electron microscopy. The levels of ionizing irradiation employed have been in excess of 500 R. These studies will be further pursued by dropping the radiation levels to totals of 100 R or less. Such cells will then be followed by time lapse motion picture studies to provide background data for inflight experiments.

VIII. The ultraviolet microbeam phase contrast television microscope is in the final days of development. When it is developed, experiments as outlined in the grant will begin immediately.



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

GRANT NSG-210-62

INTERIM PROGRESS REPORT

# TECHNICAL EVALUATION OF A ONE-INCH MINIATURIZED VIDICON IN COMBINATION WITH A MINIATURIZED PHASE MICROSCOPE

During the past several months we have had the opportunity to evaluate the performance characteristics of a one-inch miniaturized vidicon camera supplied to us by the RCA Corporation. This camera was developed for Dr. Lindsay at the Goddard Space Flight Center for the purpose of recording ultraviolet data from the sun and transmitting these data to earth. The equipment was not deliberately designed for biological experiments to be carried on in satellites.

The miniaturized vidicon was supplied with power from a power supply in our laboratory and was synchronized with a two-second monitor system derived from the ultraviolet flying spot television microscope used in this laboratory. This television monitor was in turn photographed by time lapse motion picture techniques developed for and currently employed in recording biological data by this means. The miniaturized phase microscope was obtained from Cooke, Troughton & Simms of England and has been designated by them as the McArthur Microscope.

The object of the evaluation was to determine the feasibility of using this vidicon and microscope combination for the purpose of recording, by time lapse motion picture techniques, the morphologic characteristics of living human cells as they may be resolved by a phase microscope. The life processes about which information was desired were: Pinocytosis, phagocytosis, mitochondrial structure and motion, functional integrity of the cytoplasmic sol-gel, mitosis and division rate. The cells selected for the experiment were the Chang liver cells. The experiment yielded the following data:

I. The battery light of the microscope produced adequate illumination for its use with the vidicon system. The microscope and its optical components

served their purpose and very few modifications are advisable. The most desirable modification--weight reduction--could be easily achieved by the use of lighter weight metals.

II. When the system was put into operation so that living Chang liver cells were displayed on the monitor tube and recorded by time lapse motion picture techniques several faults were readily apparent.

A. When the vidicon camera was operated at a two-second sweep with continuous illumination the tube had a storage time of the order of four minutes. This resulted in a marked loss of ability to properly focus the optical train so that the cells displayed on the monitor tube were in critical focus. In fact it was almost impossible to properly adjust the equipment under these circumstances. This fault may be rectified by the use of a pulsed light source and by arranging to erase the image from the vidicon camera after each two-second sweep.

B. The video signal was inadequately clamped and this resulted in a smearing or streaking in the image at the points of greatest contrast. Because of the nature of the biological material employed in this system these points of great black and white contrast were frequent. Further, this difficulty is inherent in any living single cell preparation. This problem may be controlled by clamping adequately for the expected contrast range.

These experiments and a study of the films of living cells derived from them indicate the necessity for laboratory evaluation of any scanning systems designed for biological experiments in satellites. This program will continue to be pursued in this laboratory.

Enclosure: Photograph of Miniaturized One-Inch Vidicon and Miniaturized Phase Microscope referred to in this progress report.